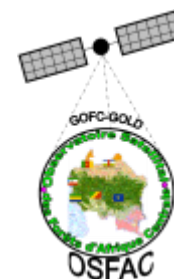




Establishing the capacity and infrastructure to use spatial data in forest monitoring and management in Central Africa

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Erik Lindquist
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Janet Nackoney
Dan Slayback
Minnie Wong





CARPE: Central Africa Regional Program for the Environment



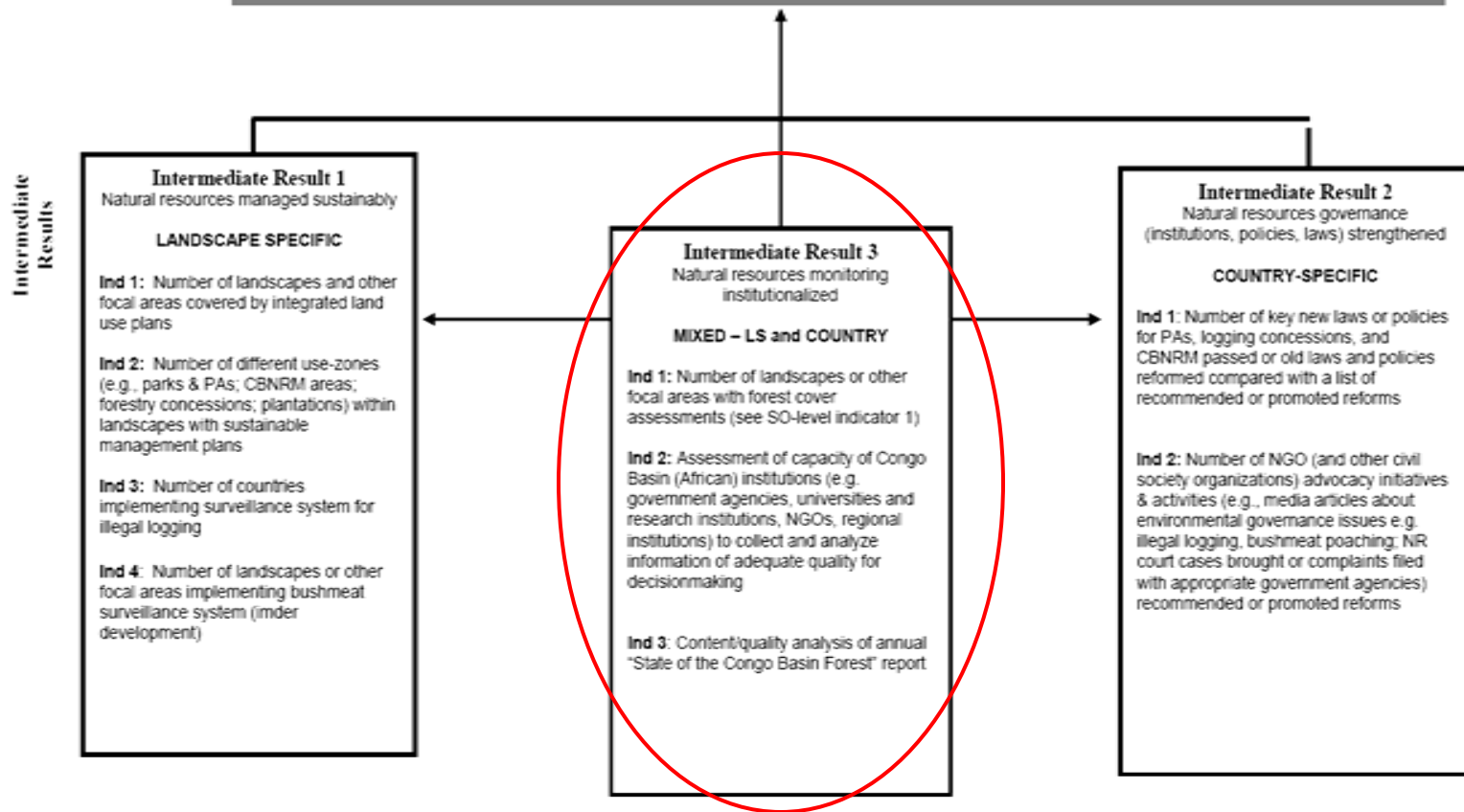
Objective

Reduce the rate of forest degradation and loss of biodiversity through increased local, national, and regional natural resource management capacity.

SO Indicators:

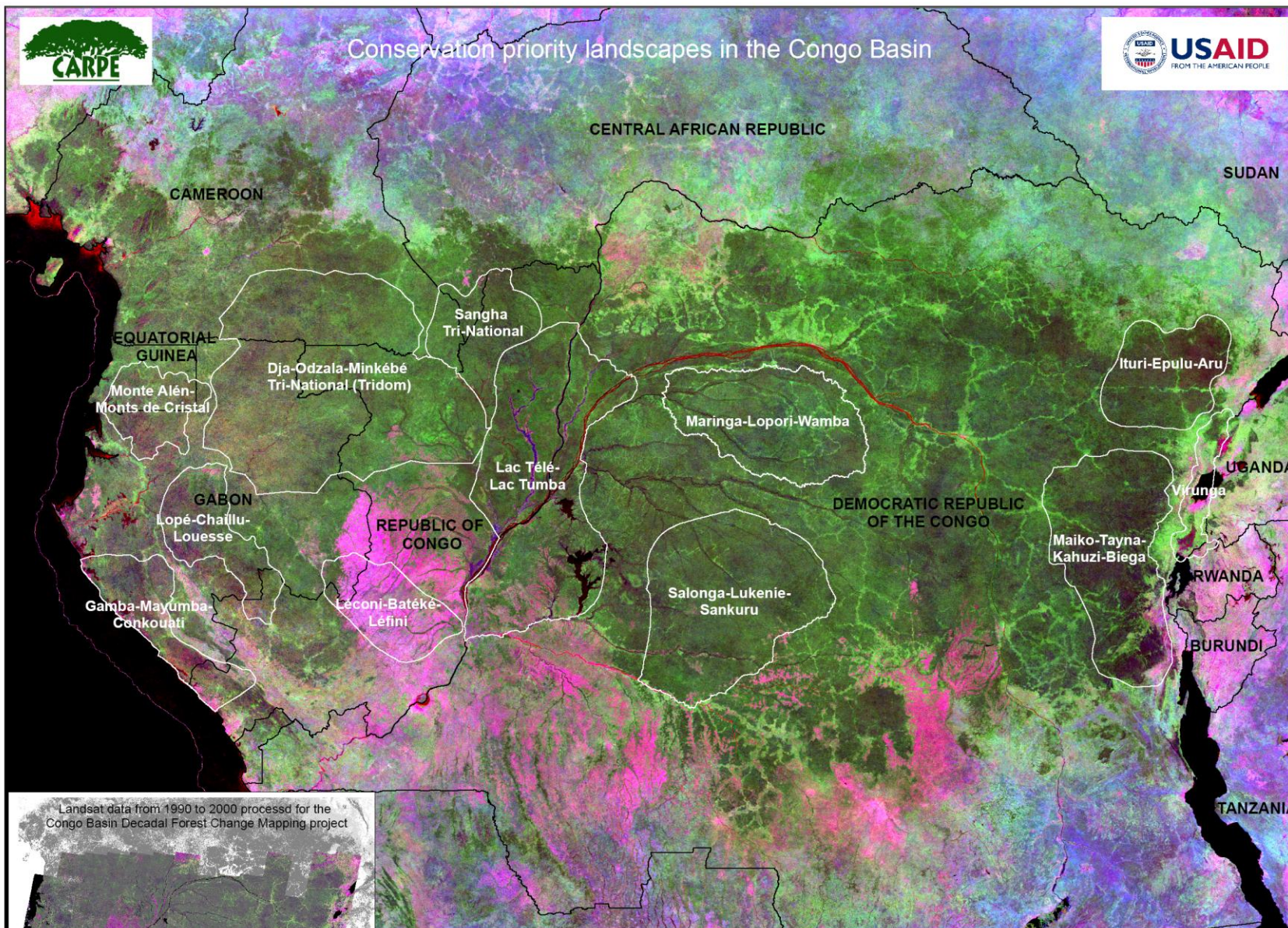
Ind 1: Change in area of forest from intact/pristine to "degraded," modified, or secondary forest or to non-forest; and from "degraded" forest to non-forest

Ind 2: Population status for selected biodiversity "indicator" species such as: wide-ranging "landscape" species and/or ecological keystone species (e.g. elephants, large predators) and/or globally threatened species (such as, mountain gorillas, bonobos, etc.)

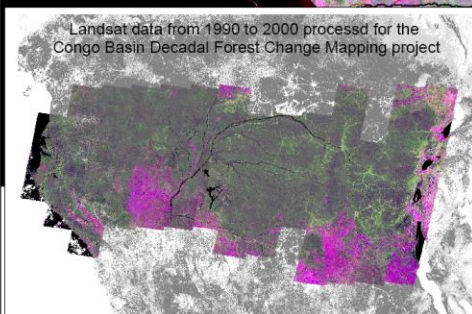




Conservation priority landscapes in the Congo Basin



Landsat data from 1990 to 2000 processed for the Congo Basin Decadal Forest Change Mapping project



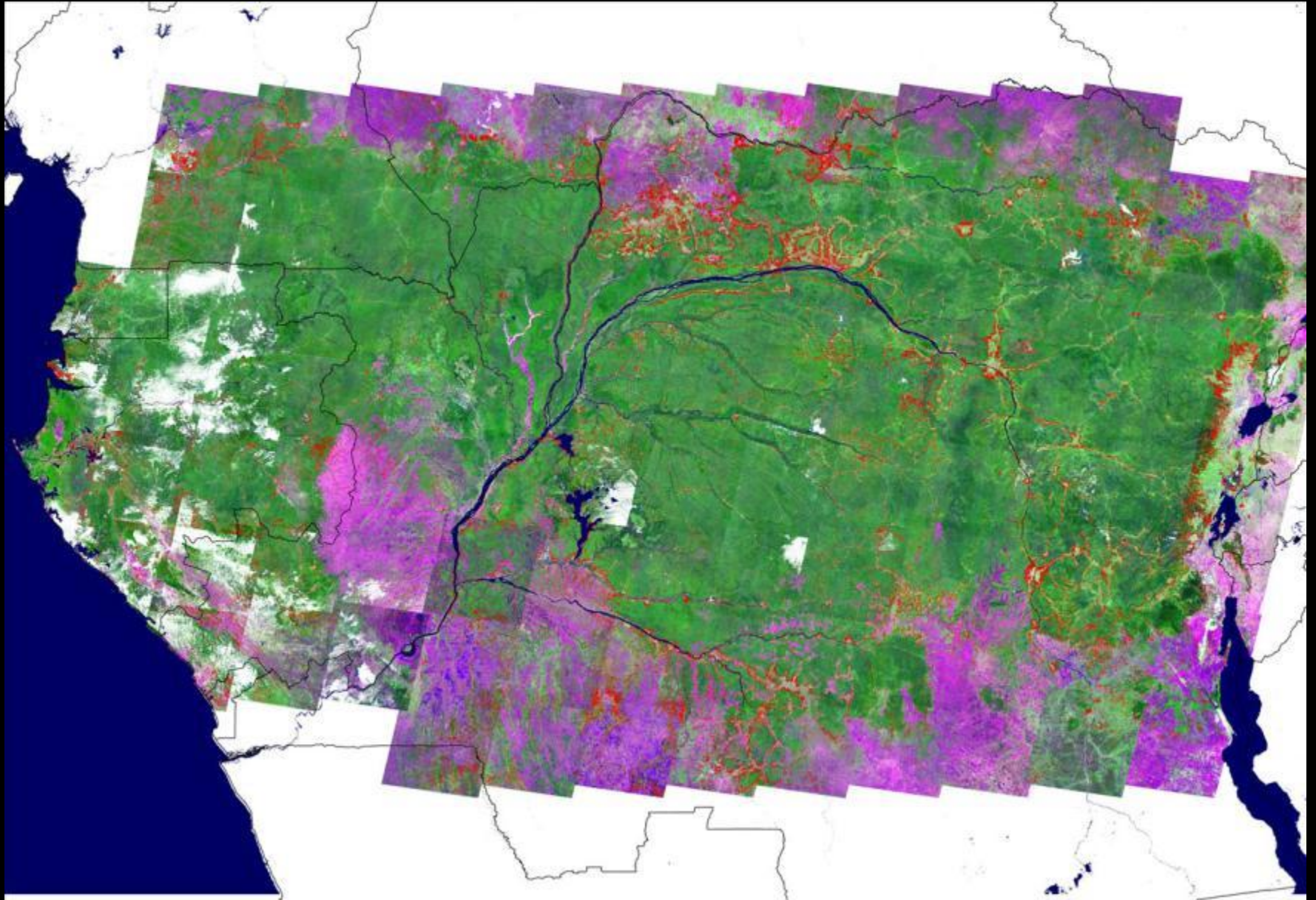
The Central African Regional Program for the Environment (CARPE) is a long-term initiative by USAID to address the issues of deforestation and biodiversity loss in the Congo Basin forest zone. One of the least developed regions of the world, the Congo Basin contains massive expanses of closed canopy tropical forest, second only to the Amazon Basin in area. These forests contain some of the most biologically diverse ecosystems in the world, and shelter a number of endangered species, including our closest relatives, chimpanzees and gorillas. Much of the forest remains relatively intact, yet unsustainable timber exploitation, shifting cultivation, urban expansion, and other human themes are posing increasing threats to this globally significant tropical forest resource. Loss of forest cover threatens both the region's biodiversity and the global climate, as these forests store large amounts of carbon dioxide. The Congo Basin Forest Partnership (CBFP) is an international initiative to address threats to the Congo Basin's natural environment. USAID supports the CBFP through CARPE. This poster depicts the twelve conservation landscapes that were identified as priority areas for conservation based on their relative taxonomic importance, their overall integrity, and the resilience of the ecological processes represented. These landscapes do not represent or suggest new protected areas. Rather, they simply serve to focus CBFP conservation activities, such as sustainable forestry management, community based natural resource management, and development of protected areas and wildlife corridors. Within these landscapes, CARPE is working with a range of government and non government organizations to conserve biodiversity and promote sustainable land use practices. For more information: United States Agency for International Development (USAID), <http://usaid.gov>, Central African Regional Program for the Environment (CARPE), <http://carpe.umd.edu>, Congo Basin Forest Partnership (CBFP), <http://cbfp.org>.

Decadal Forest Change Mapping Project

- Create forest cover and forest cover change maps that provide a baseline for future monitoring of forest resources in the Congo Basin.
- Joint effort of the University of Maryland (UMD), South Dakota State University (SDSU), and NASA/Goddard Space Flight Center.
- Mapping is an automated process that uses high resolution Landsat Thematic Mapper datasets.
- Forest change mapping began with the CARPE landscapes, but has now been completed across the Basin for circa 1990 to circa 2000. Circa 2000 to circa 2005 forest change mapping is underway.
- Goal of this project is to not only produce the baseline dataset, but also to transfer capacity for forest monitoring, as well as producing and applying related products, to the region.

DFCM dataset

(circa 1990 to circa 2000)

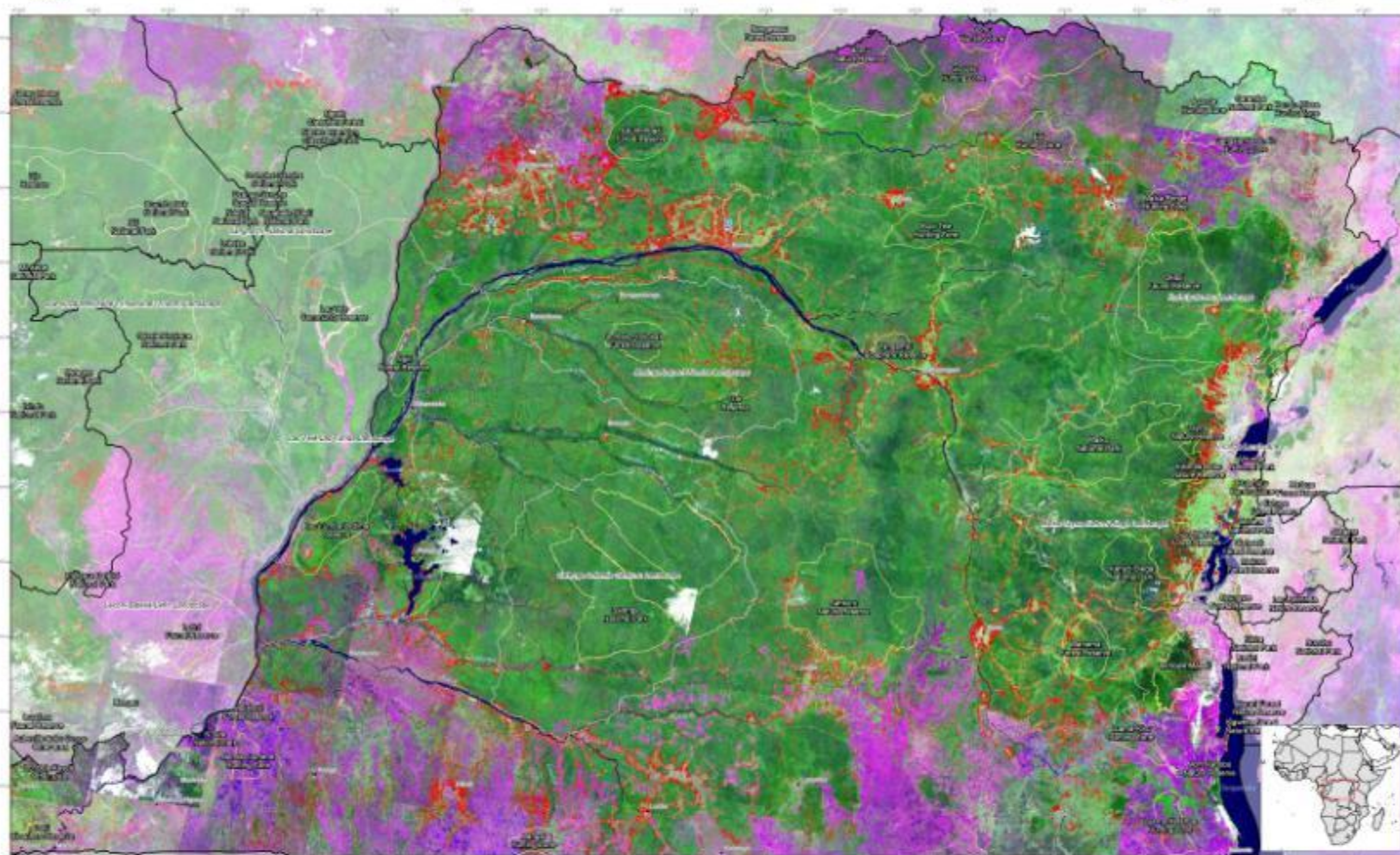


Monitoring REDD initiatives

- Systematic monitoring of deforestation, let alone degradation, is not well-established in the Congo Basin
- CARPE has developed a processing system for operationally monitoring forest clearing using exhaustive mapping
 - Forest clearing (1990-2000)
 - Congo Basin – 277 000 ha / yr
 - Inside CBFP landscapes – 46 000 ha / yr
 - Outside CBFP landscapes – 231 000 ha /yr
 - Protected areas – 10 000 ha / yr
- For carbon accounting we still need to consider within forest conversion processes – degradation
- Feasible by direct observation of degraded forest classes or spatial context/buffering if there is:
 - Coordinated earth observation data acquisition
 - Free/low cost data
 - Standardized, consensus protocols for data analysis
 - Regional/biome scale monitoring to ensure consistency between national monitoring systems
 - Distinguishing intact, non-intact and cleared forests
 - Using appropriate carbon stock data to characterize the changes between the above themes



A Decade of Change in the Forests of the Democratic Republic of Congo



Decadal Forest Change Mapping

The map illustrates a decade of forest change in the Democratic Republic of Congo (DRC). Forest cover and forest loss between circa 1990 to circa 2000 were mapped consistently at 37 meters across the Congo Basin via an automated procedure incorporating Moderate Resolution Imaging Spectroradiometer (MODIS), Landsat Enhanced Thematic Mapper (ETM+) and Thematic Mapper (TM) imagery. Forest loss, enhanced for visualization, is depicted in red overlaying a composite of Landsat imagery. This map is the first spatially explicit representation of forest cover and forest cover change over produced for the region. This information is critical for land use planning and policy formulation. Work is underway to produce a 2000 to 2005 regional forest cover change map.

| Forest Region | 1990 Forest cover (km²) | 1990 Forest loss (km²) | Forest cover loss (%) | Forest cover loss (km²) |
|-------------------------|-------------------------|------------------------|-----------------------|-------------------------|
| DRC | 1,088,910 | 1,384,425 | 12.68 | 1,384,425 |
| Inside protected areas | 147,004 | 144,306 | 9.82 | 144,306 |
| Outside protected areas | 941,906 | 1,240,119 | 13.17 | 1,240,119 |

Of the more than 1 million km² of DRC's forest area mapped in this study, approximately 2% was deforested between 1990 and 2000.

Most of the deforestation is a consequence of small scale shifting agricultural activities, which result in the expansion of the rural complex (the mosaic of settlements, fields and degraded forest) into intact forest. Logging activity is primarily manifested by the appearance of new logging roads, which can become corridors for settlement and bush-meat trading. For more information about the mapping procedure developed by South Dakota State University and the University of Maryland, in partnership with NASA, please see "The Decadal Forest Change Mapping Project" at <http://imageandresourcesolutions.com>. Data, maps and other information relevant to CARPE are available on the CARPE website at <http://carpe.usd.edu>.

CARPE: Central African Regional Program for the Environment

The Central African Regional Program for the Environment (CARPE) is a United States Agency for International Development (USAID) initiative aimed at promoting sustainable natural resource management in the Congo Basin. In recognition of the importance of the Congo Basin forest and amidst the increasing pressures facing the forest, CARPE is working to reduce the rate of forest degradation and loss of biodiversity by supporting improved local, national and regional natural resource management capacity. CARPE currently works within 12 key biodiversity landscapes in seven countries. The 12 landscapes have been identified as priority areas for conservation based on their relative economic importance, their overall integrity, and the richness of ecological processes represented.



Examples of forest change in the Democratic Republic of Congo shown left to right: Image A shows agricultural expansion into upland forest areas; degraded forest is visible; Image B shows the expansion of the rural complex and logging roads north of Burundi; and Image C shows pressure on forest resources within the park increases as forest is lost outside the park. Deforestation shown in the examples, depicted in red, has not been enhanced.



National applications of CARPE Remote Sensing Data and Products

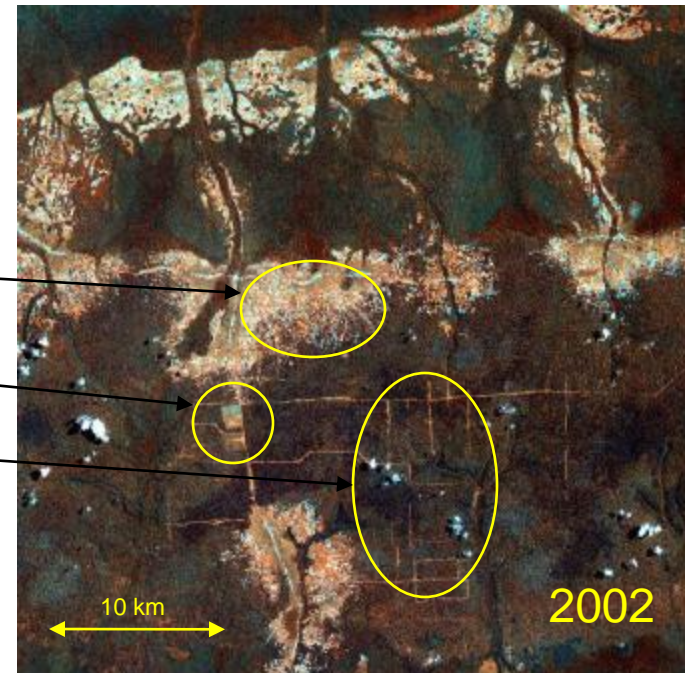
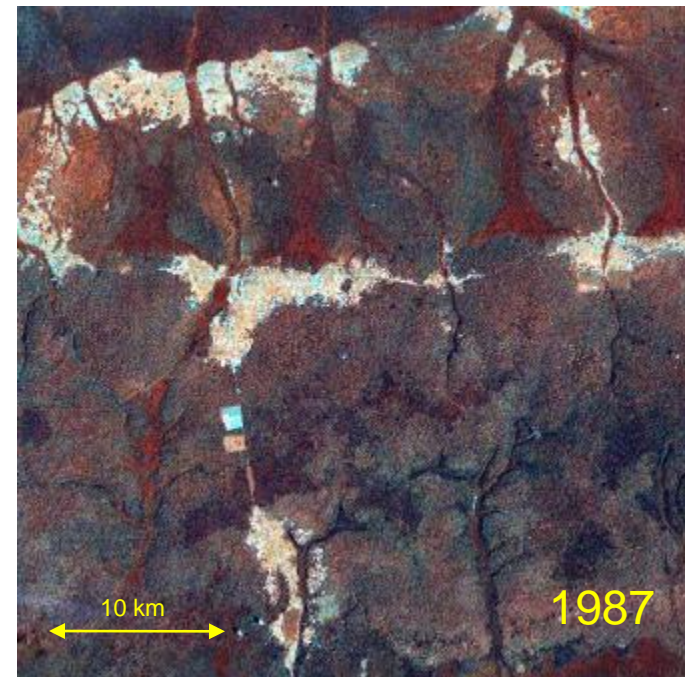
- Monitoring forest resources for carbon accounting and forestry management.
- Monitoring logging activities – both within active concessions and illegal logging.
- Monitoring of agricultural activities, both large scale, such as palm oil plantations, as well as small scale subsistence agriculture.

Land cover and land use change near Bongandanga, DRC: new logging roads and expansion of small scale agriculture into the forest.

Small scale agriculture

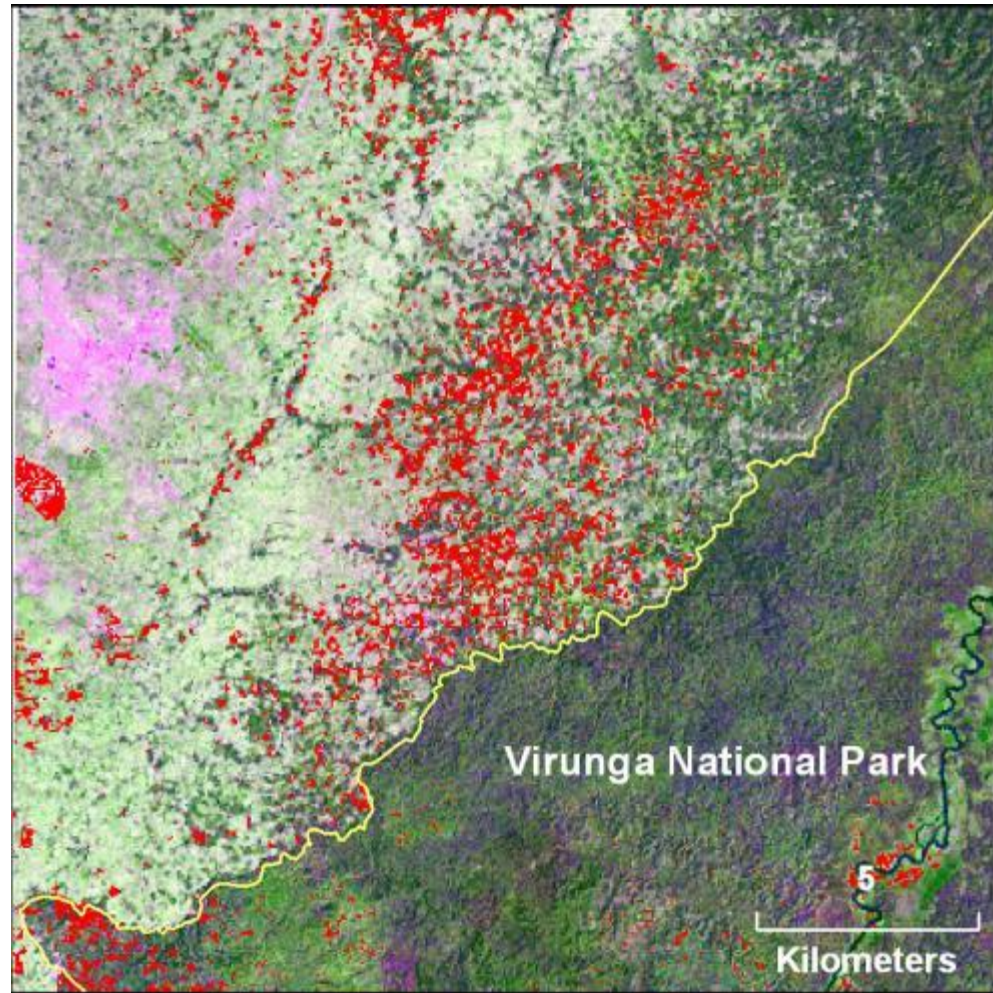
Plantations

Logging roads

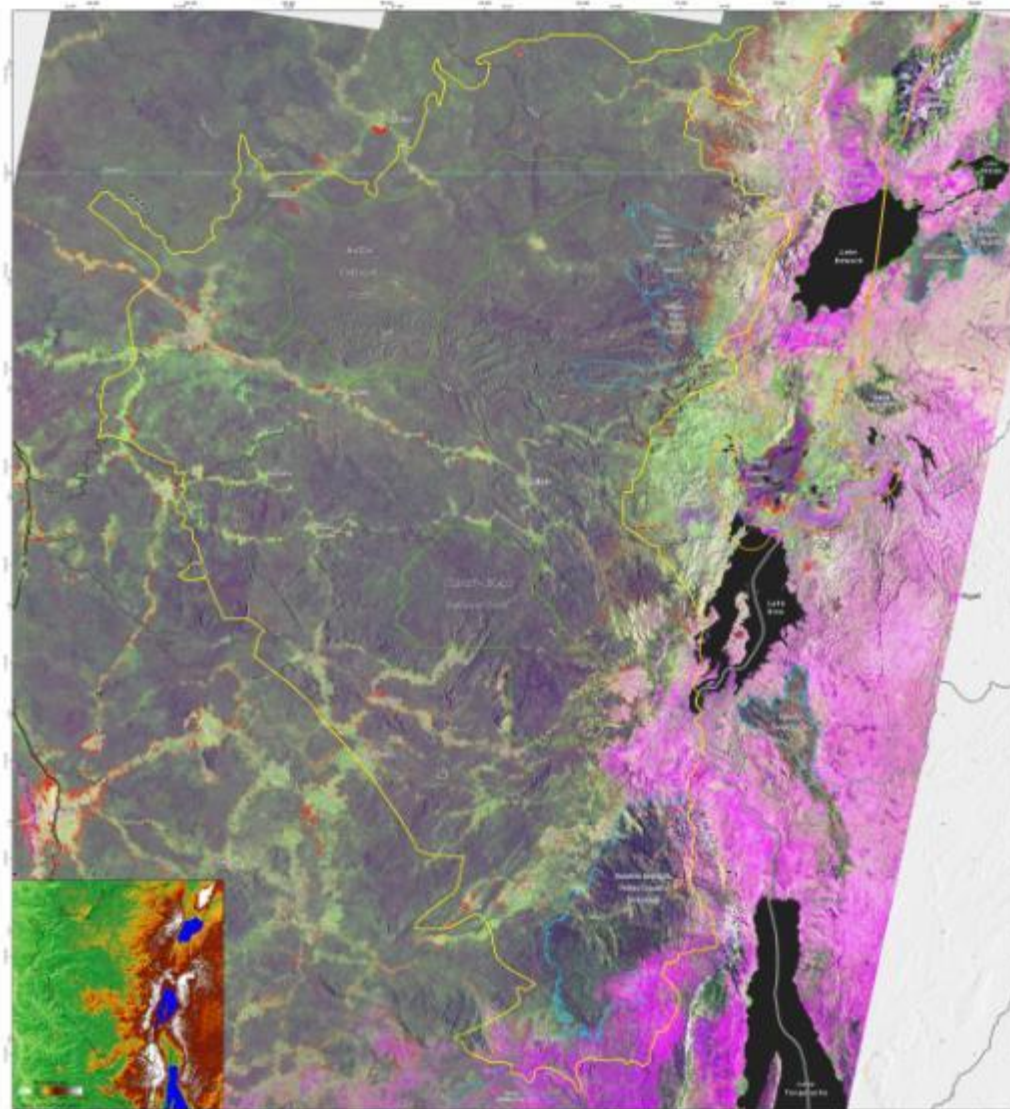


National applications of CARPE Remote Sensing Data and Products

- Identification of threats to protected areas and selection of new areas for conservation.
- Creation of national inventories of land cover and land use and harmonization of data with other sources.
- Quantifying rates of deforestation and delineating the fate of deforested land.
- Monitoring of land use change and development of land use management plans.



Deforestation (in red) from 1990-2000 near northern Virunga National Park in DRC.



Lüftung

Legend

Common waterfowl/habitats

- Yellow: Waterfowl (mostly ducks)
- Orange: Wetlands

Wetlands of value

- Light green: Wetlands of high value
- Dark green: Wetlands of medium value
- Light blue: Wetlands of low value

[illegible]

ISSN: Devle's New Region Program for the Environment

Devle's New Region Program for the Environment is a new initiative that aims to improve the environment in the region. The program is designed to help the region to become more sustainable and to improve the quality of life for its residents. The program is based on the following principles:

- To improve the environment in the region.
- To improve the quality of life for its residents.
- To become more sustainable.

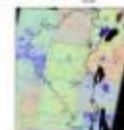
The program is designed to help the region to become more sustainable and to improve the quality of life for its residents. The program is based on the following principles:

- To improve the environment in the region.
- To improve the quality of life for its residents.
- To become more sustainable.

Local Program Goals

The local program goals are to improve the environment in the region, to improve the quality of life for its residents, and to become more sustainable. The program is designed to help the region to become more sustainable and to improve the quality of life for its residents. The program is based on the following principles:

- To improve the environment in the region.
- To improve the quality of life for its residents.
- To become more sustainable.



Remote sensing products are used to build spatially-explicit models to:

-
- Mbinga-Lopori-Wamba Landscape
Democratic Republic of Congo
Harmonized Land Cover
- Derives land cover product from
UCLSPOT1 vegetation Atlas
SRTM30 PLUS data by
Jared Harbeck of UNED
- Legend**
- Swamp forest
 - Non-forest wetland
 - Dense moist evergreen forest and evergreen forest
 - Forest: mixed age and young secondary forest
 - Urban areas
 - Water
- 0 20 40 60 80
Kilometers

Limitations to using remotely sensed datasets in Central Africa

- Prior to CARPE II capacity for RS and GIS was limited to a few individuals across the region, there was no concentration of expertise.
- National agencies identified the major constraints to using remotely sensed data and related mapping techniques as:
 - Cost
 - Lack of local expertise
 - Lack of basic resources (esp. among govt. agencies)
 - Data accessibility
 - High resolution data remains a problem
 - Costs
 - Persistent cloud cover
 - No receiving station in Central Africa
 - Landsat 7 SLC malfunction
 - Landsat 5 beyond expected operation
 - Options: ASTER, IRS, CBERS, ALOS
- Constraints remain substantial across most of Central Africa.

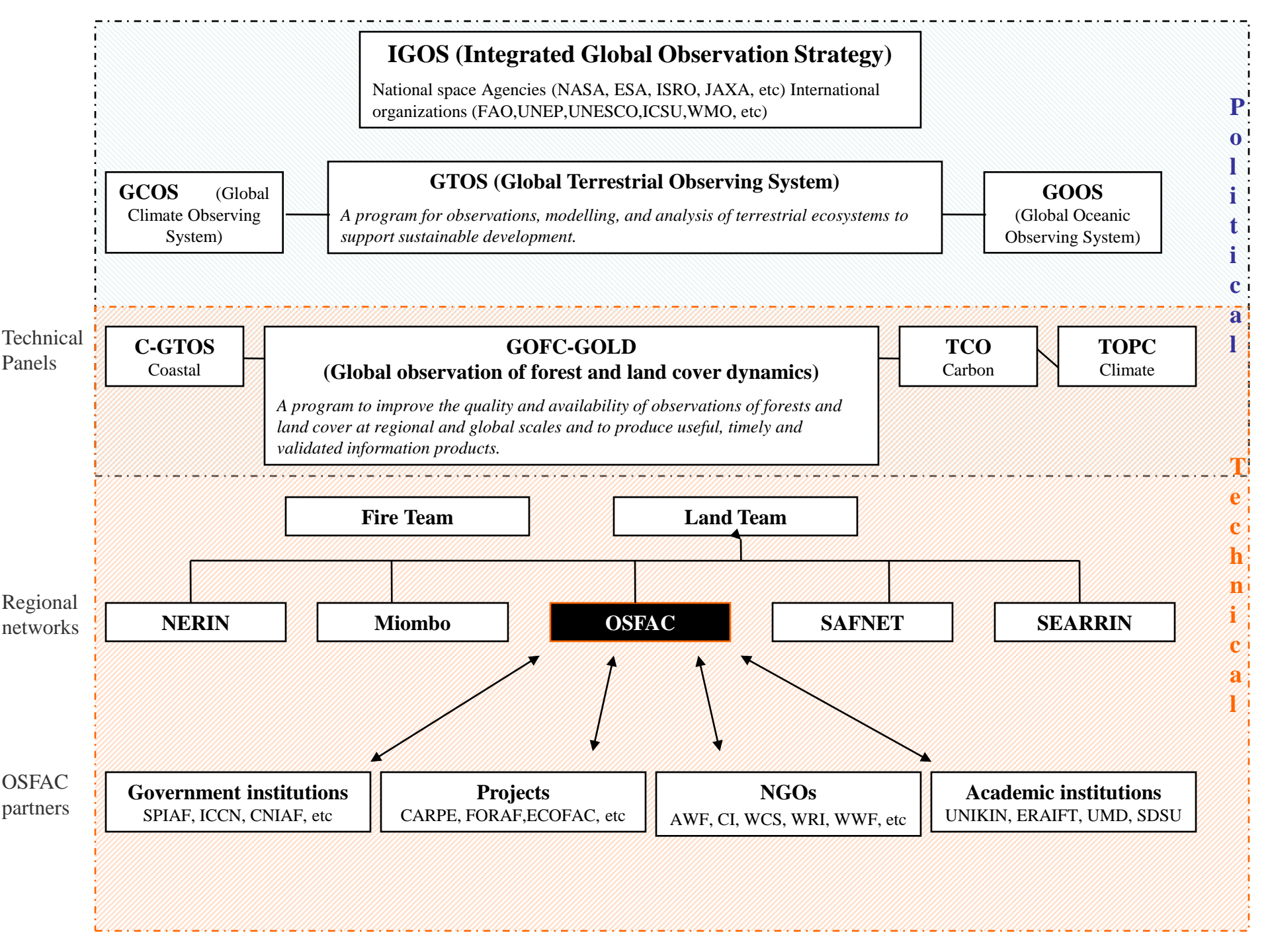


OSFAC

(Observatoire satellital des forêts d'Afrique Centrale)

- Established as GOFC-GOLD Central Africa network in 2005
- Secretariat operates as legally recognized NGO in DRC with 7 full-time staff
- Receives technical backstopping and financial support from NASA, UMD and SDSU through CARPE
- Maintains a RS GIS lab within the School of Agronomy at the University of Kinshasa (UNIKIN)



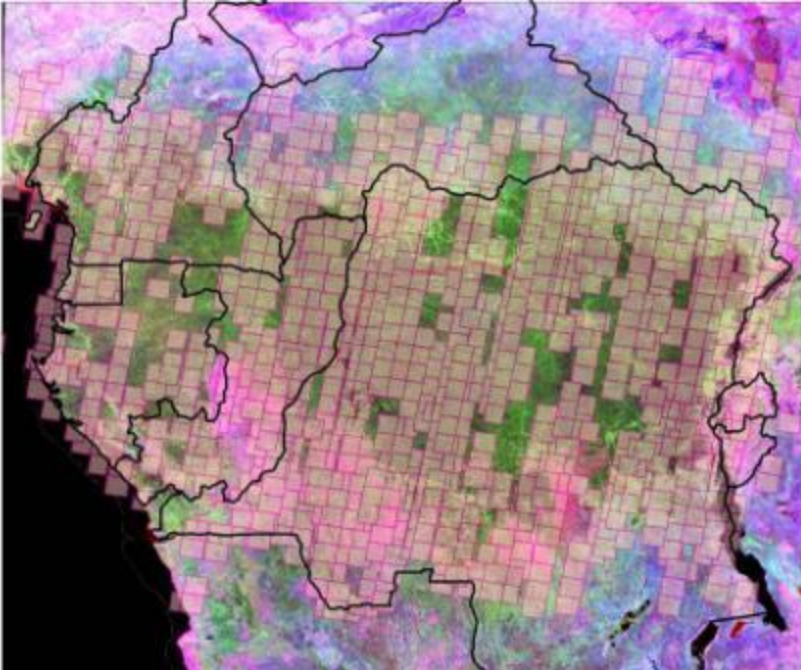




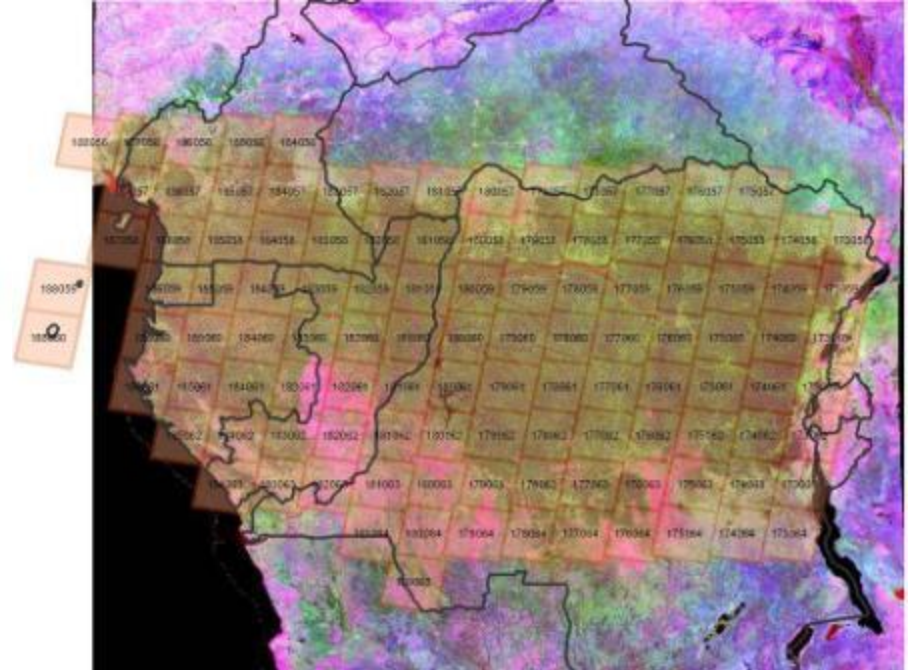
Improving Data Accessibility

- Serves as a clearing house for satellite data in Central Africa distributing satellite imagery and RS products
 - Database of data holdings
 - Website (www.osfac.umd.edu)
- Catalogue of spatial datasets (GIS working group, MAFA, etc.)

ASTER data coverage



LANDSAT data coverage





Building RS GIS capacity in Central Africa

1. Exchange programs and higher level technical trainings
 - SDSU, UMD, UCL
 - OSFAC RS training
2. Periodic basic technical trainings
 - usually 1-4 weeks
 - focus on ArcView, ArcGIS, or ENVI

| | Men | Women | Total |
|--------------|------------|-----------|------------|
| Trainees | 383 | 60 | 443 |
| Interns* | 19 | 9 | 28 |
| Total | 402 | 69 | 471 |



* Interns are often degree seeking students who wish to incorporate spatial data analysis in their theses

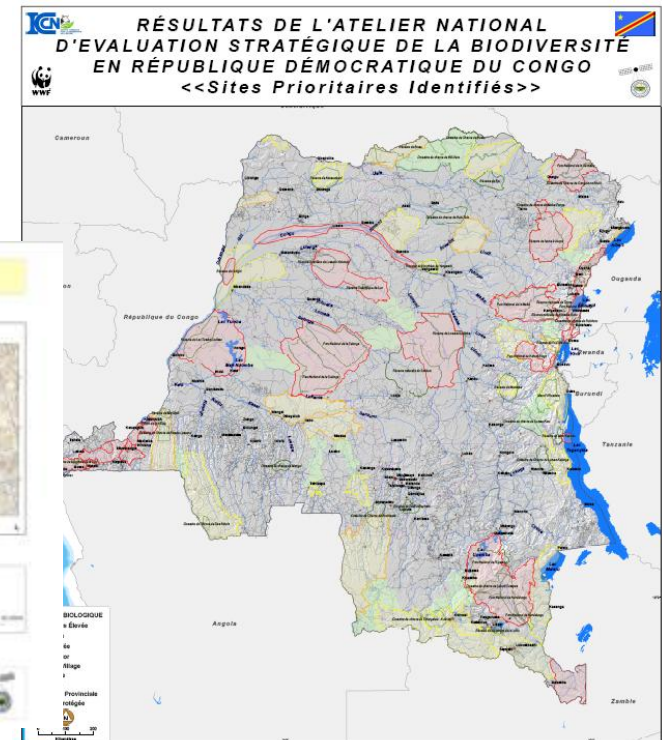
- **AWF** (African Wildlife Foundation)
- **Bombo Lumene Hunting Zone**, DRC
- **BCI** (Bonobo Conservation Initiative)
- **BEAU** (Bureau d'études et d'aménagement urbain)
- **CAMI** (Cadastre minier)
- **CENAREST** (Centre national de recherche scientifique et technologique)
- **CIB** (Congolaise industrielle des bois)
- **CICOS** (La commission internationale du bassin du Congo- Oubangui-Sangha)
- **CNIE** (Cadre national de l'information environnementale)
- **CNPN** (Conseil national des parcs nationaux, Gabon)
- **COHYDRO** (Congolaise des hydrocarbures)
- **Conkouati-Douli National Park**, Republic of Congo
- **CRGM** (Centre de recherche géologique et minière)
- **CTB** (Coopération technique belge-FSU, PU, RRBC, RIB, AILD-KIN)
- **CTCPM** (La Cellule Technique de Coordination et de Planification Minière)
- **DGF** (Direction de gestion forestière)
- **ECODED** (Economie et développement durable)
- **ERAIFT** (Ecole régionale d'aménagement intègre des forêts tropicales)
- **FACAGRO** (Faculte d'agronomie)
- **Garamba National Park**, DRC
- **ICCN** (Institut Congolaise pour la conservation de la nature)
- **IPS** (Inspection provincial de la sante)
- **IRM** (Innovative Resource Management)
- **ITTO** (International Tropical Timber Organization)
- **Kahuzi Biega National Park**, DRC
- **Lac Télé Community Reserve**, Republic of Congo

- **Lopé Reserve**, Gabon
- **MECNEF** (Ministère de l'environnement, conservation de la nature, eaux et forets)
- **SNR/MECNEF** (Service national de reboisement)
- **MECNT** (Ministère de l'environnement, conservation de la nature et tourisme)
- **MEFE** (Ministère de l'economie forestière et l'environnement, République du Congo)
- **MINEF** (Ministère de l'economie forestière, Gabon)
- **Minkébé National Park**, Gabon
- **Nouabale Ndoki National Park**, Republic of Congo
- **OCHA/UN** (Office for the Coordination of Human Affairs)
- **Okapi Faunal Reserve**, DRC
- **PAIDECO** (Programmes d'appui aux initiatives de développement communautaire)
- **PARCAFRIQUE**
PNLTHA (Programme nationale de lutte contre la trypanosomiase humaine africaine)
- **PROGEPP** (Projet de gestion des écosystèmes périphériques du parc national de Nouabalé-Ndoki)
- **Salonga National Park**, DRC
- **SPIAF** (Service permanent d'inventaire forestier)
- **SYGIAP** (Système de gestion des aires protégées)
- **TRIDOM** (Dja-Odzala-Minkébé Tri-National)
- **UNICEF** (United Nations Children's Fund)
- **UNIKIN** (University of Kinshasa)
- **UNILU** (University of Lubumbashi)
- **Virunga National Park**, DRC
- **WCS** (Wildlife Conservation Society)
- **WRI** (World Resources Institute)
- **WWF** (World Wildlife Fund)



OSFAC GIS RS capacity

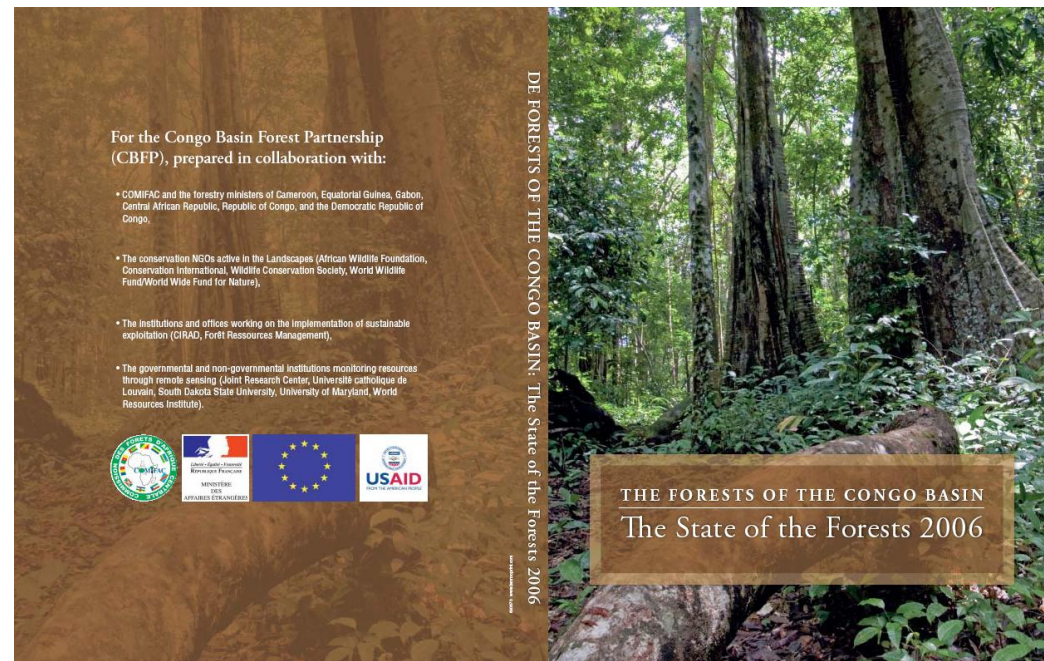
- GIS capacity is high
- RS capacity remains low to medium





OSFAC long-term objectives

- establish sustainability for OSFAC network
- establish routine forest cover monitoring of the Congo Basin by transferring capacity for SDSU/UMD methodology to the region
- work with government agencies to produce useful products for managers and decision-makers
- work with local agencies to determine accuracy of estimates and combine with in situ datasets



Forest Observatory for Central Africa

Information sharing tool to promote good governance and the sustainable management of forest ecosystems

